and Geodetic Survey and the Weather Bureau, the lines of research of which, existing or proposed, do not seem wholly distinct from those indicated in the programme. Even European magneticians might feel some slight uneasiness lest a department of so novel a kind, and displaying such unusual readiness to "pay the piper," might not display a corresponding proclivity to "call the tune." One can thus understand the occasion for the director's assurance that the general policy of the department is "not to supplant any existing organisation . . . but rather to supplement and to cooperate in the most effective manner."

REPORT UPON THE CALIFORNIAN EARTHQUAKE OF APRIL 18.

A PRELIMINARY report of the commission appointed by the Governor of California on April 21 to obtain information concerning the earthquake of April 18 has reached us. The commission includes Prof. A. C. Lawson, State University of California, chairman; Prof. G. K. Gilbert, U.S. Geological Survey; Prof. Fielding Reid, Johns Hopkins University; Prof. J. C. Branner, Stanford University; Profs. A. O. Leuschner and George Davidson, State University; Prof. C. Burkhalter, Chabot Observatory; and Prof. W. W. Campbell, director of the Lick Observatory.

The scope of the work of the commission in its preliminary stages embraced the questions as to the origin, position, and character of the disturbance in the earth's crust which gave rise to the Californian earthquake. Having decided upon the scope of its work, the commission appointed three subcommittees to deal respectively with isoseismals, coseismals, and the geophysics of the earthquake. The cooperation of the San Francisco branch of the American Association of Civil Engineers was secured, and the work of its members greatly simplified the collection of data.

The committee on coseismals, being concerned with the records of times at which the earthquake was felt, had to depend largely upon correspondence for information, and for times automatically registered the committee is indebted to seismologists in many countries. Numerous other observations were supplied by officers in the various public services. The committee on isoseismals has also received assistance from many sources.

Subjoined is a summary of the chief results obtained up to the present.

One of the remarkable features of the Coast Ranges of California is a line of peculiar geomorphic expression which extends obliquely across the entire width of the mountainous belt from Mendocino County to Riverside County. The peculiarity of the surface features along this line lies in the fact that they are not due, as nearly all the other features of the mountains are, to atmospheric and stream erosion of the uplifted mass which constitutes the mountains, but have been formed by a dislocation of the earth's crust, or rather a series of such dislocations, in time past, with a differential movement of the parts on either side of the plane of rupture. In general, this line follows a system of long, narrow valleys, or where it passes through wide valleys it lies close to the base of the confining hills, and these have a very straight trend; in some places, however, it passes over mountain ridges, usually, at the divide separating the ends of two valleys; it even in some cases goes over a spur or shoulder of a mountain. Along this line are very commonly found abrupt changes in the normal slope of the valley sides giving rise to what are technically known as scarps. These scarps have the appearance of low, precipitous walls, which have been usually softened and rounded somewhat by the action of the weather. Small basins or ponds, many having no outlet, and some containing saline water, are of fairly frequent occurrence, and they usually lie at the base of the small scarps. Trough-like depressions also occur, bounded on both sides by scarps. These troughs and basins can only be explained as due to an actual subsidence of the ground, to an uplift of the ground on one side or the other, or on both sides. The scarps similarly can only be ascribed to a rupture of the earth with a relative vertical displacement along the rupture plane. Frequently small knolls or sharp little ridges are found to characterise this line, and these are bounded on one side by a softened scarp and separated from the normal slope of the valley side by a line of depression. In many cases these features have been so modified and toned down by atmospheric attack that only the expert eye can recognise their abnormal character; but where their line traverses the more desert parts of the coast range, as, for example, in the Carissa Plains, they are well known to the people of the country, and the aggregate of the features is commonly referred to as the "earthquake crack."

This line, which can be traced from Point Arena to Mount Pinos, in Ventura County, has a length of 375 miles, is remarkably straight, and cuts obliquely across the entire breadth of the Coast Ranges. To the south of Mount Pinos the line either bends to the eastward, following the general curvature of the ranges, or is paralleled by a similar line offset from it *en echelon*; for similar features are reported at the Tejon Pass, and traceable thence, though less continuously, across the Mojave Desert to Cajon Pass and beyond this to San Jacinto and the south-east border of the Colorado Desert. The probability is that there are two such lines, and that the main line traced from Point Arena to Mount Pinos is continued with the same general straight trend past San Fernando and along the base of the remarkably even fault scarp at the foot of which lies Lake Elsinore. But, leaving the southern extension of the line out of consideration as somewhat debatable, we have a very remarkable physiographic line extending from Point Arena to Mount Pinos which affords every evidence of having been in past time a rift, or line of dislocation, of the earth's crust, and of recurrent differential movement along the plane of rupture. The movements which have taken place along this line extend far back into the Quaternary period, as indicated by the major, well-degraded fault scarps and their associated valleys; but they have also occurred in quite recent times, as is indicated by the minor and still undegraded scarps. Probably every movement on this line produced an earthquake, the severity of which was proportionate to the amount of movement.

The cause of these movements in general terms is that stresses are generated in the earth's crust which accumulate until they exceed the strength of the rocks composing the crust, and they find a relief in a sudden rupture. This establishes the plane of dislocation in the first instance, and in future movements the stresses have only to accumulate to the point of overcoming the friction on that plane and any cementation that may have been effected in the intervals between movements.

The earthquake of April 18 was due to one of these movements. The extent of the rift upon which the movement of that date took place is at the time of writing not fully known. It is, however, known from direct field observations that it extends certainly from the mouth of Alder Creek, near Point Arena, to the vicinity of San Juan, in San Benito County, a distance of about 185 miles. The destruction at Petrolia and Ferndale, in Humboldt County, indicates that the movement on the rift extended at least as far as Cape Mendocino, though whether the rift lies inland or off-shore remains as yet a matter of inquiry. Adding the inferred extension of the movement to its observed extent gives us a total length of about 300 miles. The general trend of this line is about N. 35° W., but in Sonoma and Mendocino counties it appears to have a slight concavity to the north-east, and if this curvature be maintained in its path beneath the waters of the Pacific it would pass very close to, and possibly inside of, Capes Gordo and Mendocino. Along the 185 miles of this rift where movement has actually been observed, the displacement has been chiefly horizontal on a nearly vertical plane, and the country to the south-west of the rift has moved north-westerly relatively to the country on the north-east of the rift. By this it is not intended to imply that the north-east side was passive and the south-west side active in the movement. Most probably the two sides moved in opposite directions. The evidence of the rupture and of the differential movement along the line of rift is very

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clear and unequivocal. The surface soil presents a continuous furrow generally several feet wide with transverse cracks which show very plainly the effort of torsion within the zone of the movement. All fences, roads, stream courses, pipe lines, dams, conduits, and property lines which cross the rift are dislocated. The amount of dislocation varies. In several instances observed it does not exceed 6 feet. A more common measurement is 8 feet to 10 feet. In some cases as much as 15 feet or 16 feet of horizontal displacement has been observed, while in one case a roadway was found to have been differentially moved 20 feet. Probably the mean value for the amount of horizontal displacement along the rift line is about 10 feet, and the variations from this are due to local causes, such as drag of the mantle of soil upon the rocks, or the excessive movement of soft incoherent deposits. Besides this general horizontal displacement of about 10 feet, there is observable in Sonoma and Mendocino counties a differential vertical movement not exceeding 4 feet, so far as at present known, whereby the south-west side of the rift was raised relatively to the north-east side, so as to present a low scarp facing the north-east. This vertical movement diminishes to the south-east along the rift line, and in San Mateo County is scarcely, if at all, observable. Still farther south there are suggestions that this movement may have been in the reverse direction, but this needs further field study.

As a consequence of the movement, it is probable that the latitudes and longitudes of all points in the Coast Ranges have been permanently changed a few feet, and that the stations occupied by the Coast and Geodetic Survey in their triangulation work have been changed in position. It is hoped that a reoccupation of some of these stations by the Coast and Geodetic Survey may contribute data to the final estimate of the amount of movement.

The great length of the rift upon which movement has occurred makes this earthquake unique. Such length implies great depth of rupture, and the study of the question of depth will, it is believed, contribute much to current geophysical conceptions.

The time of the beginning of the earthquake as recorded in the observatory at Berkeley was 5h. 12m. 6s. a.m., Pacific standard time. The end of the shock was 5h. 13m. 11s. a.m., the duration being 1m. 5s. Within an hour of the main shock twelve minor shocks were observed by Mr. S. Albrecht, of the observatory, and their time accurately noted. Before 6h. 52m. p.m. of the same day thirty-one shocks were noted in addition to the main disturbance. These minor shocks continued for many days after April 18, and in this respect the earthquake accords in behaviour with other notable earthquakes in the past. The minor shocks which succeed the main one are interpreted generally as due to subordinate adjustments of the earth's crust in the tendency to reach equilibrium after the chief movement.

The destructive effects of the earthquake are in the main distributed with reference to the line of rift. The exact limits of the area of destruction have not yet been mapped, but it is known to extend out about twenty-five or possibly thirty miles on either side of the rift. On the south-west side the greater part of this area to the north of the Golden Gate lies in the Pacific. This area extends from Eureka, in Humboldt County, to the southern extremity of Fresno County, a distance of about 400 miles.

Beyond this area of destructive shock the earthquake was felt in its milder manifestations over a wide territory. Our reports to date show that it was felt in Oregon as far north as Coos Bay, and on the south as far as Los Angeles. To the east it was felt over the greater part of middle California and eastern Nevada, particularly along the eastern flank of the Sierra Nevada. It was felt at Lovelocks, and we have unconfirmed reports of its having been felt at Winnemucca. Far beyond the region within which it was apparent to the senses, however, the earth wave was propagated both through the earth and around its periphery, and some of the most valuable and most accurate records of the disturbance which we have are those which were registered at such distant seismographic stations as Washington, D.C.; Sitka, Alaska; Potsdam, Germany; and Tokyo, Japan.

Within the area of destructive effects, approximately 400 miles by 50 miles in extent, the intensity varied greatly. There was a maximum immediately on the rift line. Water pipes, conduits, and bridges crossing this line were rent asunder. Trees were uprooted and thrown to the ground in large numbers. Some trees were snapped off, leaving their stumps standing, and others were split from the roots up. Buildings and other structures were in general violently thrown and otherwise wrecked, though some escaped with but slight damage. Fissures opened in the earth and closed again, and in one case reported a cow was engulfed. A second line of maximum destruction lies along the floor of the valley system of which the Bay of San Francisco is the most notable feature, and particularly in the Santa Rosa and Santa Clara valleys. Santa Rosa, situated twenty miles from the rift, was the most severely shaken town in the State, and suffered the greatest disaster relatively to its population and extent. Healdsburg suffered to a nearly similar degree. San José, situated thirteen miles, and Agnews, about twelve miles, from the rift, are next in the order of severity. Stanford University, seven miles from the rift, is probably to be placed in the same category. All of these places are situated on the valley floor, and are underlain to a considerable depth by loose or but slightly coherent geological formations, and their position strongly suggests that the earth waves as propagated by such formations are much more destructive than the waves which are propagated by the firmer and highly elastic rocks of the adjoining hill lands.

One of the lessons of the earthquake which seems peculiarly impressive is the necessity for studying carefully the site of proposed costly public buildings where large numbers of people are likely to be congregated. In so far as possible such sites should be selected on slopes upon which sound rock foundation can be reached. It is probably in large measure due to the fact of their having such a rock foundation that the buildings of the State University, at Berkeley, escaped practically uninjured.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. DOELTZ, privatdocent for metallurgy in the Bergakademie in Klausthal, has been appointed professor of metallurgy in the Charlottenburg Technical High School in succession to Geheimrat Weeren, and will enter on his new duties on October 1.

THE council of the University of Birmingham has approved of a scheme for the foundation of a department of economic zoology, and has appointed Mr. Walter E. Collinge the special lecturer on that subject. By this arrangement, Mr. Collinge will vacate his lectureship in zoology and comparative anatomy, and take over the new department at premises at present being fitted up at 55 Newhall Street. These comprise an inquiry office, consultation room, research laboratory, and museum.

ONE of the most satisfactory features of American university education is the keen interest shown by old students in their respective colleges. We learn from *Science* that at the recent alumni meeting at Harvard University it was stated that during the year graduates had contributed about 360,310*l.* to the productive funds of the University, and that 17,623*l.* had been received for immediate use. This sum does not include the more than 22,600*l.* that the class of one year has given to the University to be used as the corporation sees fit. An anonymous gift of 12,000*l.* from a graduate was also announced. Another instance of the same enthusiasm is shown by President Hadley's announcement at the Yale alumni dinner that the total of the alumni fund for the year amounted to 25,847*l.*, as compared with the 10,700*l.* announced a year ago. From our contemporary we also learn that a fund of 30,000*l.*, of which Mr. Carnegie contributed 15,000*l.*, has been raised at Amherst College, and will be used to provide for the work in geology and biology. Mrs. Louisa N. Bullard, too, has given Harvard University Medical School 10,400*l.* to establish a chair of neuropathology.

MR. HALDANE, Secretary of State for War, distributed the prizes on July 13 to the students and nursing pro-

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